THE

RAILWAY LIGHTING AND HEATING COMPANY'S

FROST DRY CARBURETTER SYSTEM

FOR

LIGHTING PASSENGER and OTHER RAILROAD CARS.

PHILADELPHIA, PENNA.,
U. S. A.
1888.

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Introduction.

The Frost Dry Carburetter System, for lighting Passenger and other Railroad Cars, is now so thoroughly perfected that it can be presented to Railroad Managers with the utmost confidence in its simplicity, cheapness, safety and vastly enlarged volume of light.

It has been well tested and then adopted by the Railroad Management that controls the largest car equipment of the continent, and all that is claimed for it can be so fully and so easily verified, that it needs only unbiased inquiry to assure its prompt adoption.

All that is asked for this wonderful combination of simplicity, safety and economy, with vastly the best lights ever put in a car, is impartial investigation and a test of its merits, and it will speedily command the approval and patronage of the Railroad Systems of the World.

INDEX.

THE

RAILWAY LIGHTING AND HEATING COMPANY.

OFFICE AND FACTORY,

1110, 1112, 1114 and 1116 Sansom Street,

PHILADELPHIA, PA.,

U. S. A.

OFFICERS:

WINFIELD S. WOLFORD, ...	PRESIDENT.
EDWARD J. FROST, ...	GENERAL MANAGER.
RICHARD M. POPHAM, ...	SECRETARY AND TREASURER.

June 1st, 1889.

SATISFACTORY LIGHTING

OF

PASSENGER AND OTHER RAILROAD CARS

INVOLVES THE FOLLOWING CONDITIONS:

1st. It should be safe beyond the suspicion of danger.

2d. It should be economical in cost.

3d. It should be a perfect system of ventilation.

4th. It should be so effective and evenly distributed that passengers in any part of the car can read easily and comfortably.

5th. It should be simple in operation, absolutely reliable and of constant quality.

THESE CONDITIONS ARE MET ONLY

BY THE

FROST DRY CARBURETTER SYSTEM.

CAR LIGHTING

BY THE

FROST DRY CARBURETTER SYSTEM.

EACH CAR IS ABSOLUTELY INDEPENDENT FOR ITS LIGHT
AND REQUIRES
NO EXPENSIVE CHARGING PLANTS TO OPERATE IT.

EXTREME DURABILITY AND SIMPLICITY.

BEAUTY AND BRILLIANCY OF LIGHT.

PERFECT SYSTEM OF VENTILATION.

ECONOMICAL BEYOND PRECEDENT.

NOMINAL COST OF MAINTENANCE.

ABSOLUTE SAFETY.

THE

RAILWAY LIGHTING AND HEATING COMPANY'S

FROST DRY CARBURETTER SYSTEM,

FOR

LIGHTING PASSENGER AND OTHER RAILROAD CARS.

Since the introduction of the Westinghouse Air-Brake the greatest improvement in railroad passenger service has been the invention of a cheap and efficient light, made possible by the use of air from the air-brake service and the volatile oils obtained from petroleum. These two elements, combined in proper proportions, have long been known to produce the cheapest and best illuminating gas.

The greatest obstacle to the use of this class of light has been the danger attending the storage of these volatile oils in passenger cars. This difficulty has been entirely overcome by the FROST DRY CARBURETTER SYSTEM, in which the oil is absorbed by the capillary attraction of cotton wicking, and gradually yields its hydro-carbon to a current of air, which is forced through the entire mass and conveyed thence to the burner, in such proportions as to give the best results in the way of economy and brilliancy of light.

The carburetter is completely filled with wicking, so that the gasoline is taken up by capillary attraction and held in suspension, THUS AVOIDING THE PRESENCE OF ANY OF IT IN FLUID FORM.

The next difficulty was to overcome the effects of variation in the temperature, as it is well known that, in the heat of summer, air-gas gives a rich and brilliant light, which becomes poor and feeble with the advent of winter. This difficulty has been entirely overcome by placing a small generator or carburetter above each light, in the roof of the car, in such a manner that a portion of the heat generated by

the burner is transmitted to the carburetter, insuring a uniform temperature at all seasons, and thus supplying the necessary heat for perfect vaporization, and all the conditions favorable to perfect combustion, and steady, uniform light are thus afforded. A storage air-tank is placed under each car in order to render it independent of the air-brake service, as the tank (if the car be detached from the train) contains sufficient compressed air to sustain the lights about six (6) hours,—the air being retained by means of a check-valve placed between the tank and the air-brake pipe. This compressed air is carried by means of pipes into the saloon, where the pressure is regulated, thence to the roof of the car, supplying the carburetters successively.

It will be observed that, by this method, NO GAS IS CARRIED THROUGH THE PIPES CONNECTED WITH THE SYSTEM, as the gas is conveyed directly from the carburetter to the burner beneath. To insure absolute safety, the carburetter is inclosed in a heavy, seamless copper casing, which, in turn, is surrounded by a double kalamein iron mantle.

In charging, a small can containing sufficient oil (two [2] gallons) is attached to the carburetter, making a gas-tight joint, and a train-hand can charge the entire car in about five (5) minutes. This, in ordinary service, will last about two (2) weeks, and as no machinery is employed, the cars can be charged at any desired point with very little expense.

THE GREAT ADVANTAGES OF THIS SYSTEM ARE—

1st.—Each car is absolutely independent, as it carries its own plant.

2d.—The absence of expensive charging plants, and the cost of maintaining the same.

OUR ENTIRE PLANT NECESSARY TO OPERATE, IS A CHARGING CAN. SEE PLATE P.

3d.—There is nothing to wear out, deteriorate or become obsolete.

4th.—Extreme durability and simplicity.

5th.—Beauty and brilliancy of light.

6th.—Perfect system of ventilation.

7th.—Economical beyond precedent.

8th.—Nominal cost of maintenance.

9th.—ABSOLUTE SAFETY.

THE FROST DRY CARBURETTER SYSTEM

for lighting passenger and other railroad cars, is far superior in every particular, to any light of the present time.

THE FROST DRY CARBURETTER SYSTEM

has proven under all circumstances and conditions to be the only system that will thoroughly light and ventilate cars, AND FOR THE PERFECT VENTILATION OF SLEEPING CARS, IT SURPASSES ALL KNOWN SYSTEMS.

THE FROST DRY CARBURETTER SYSTEM

is not an experiment, and it has shown that it is not only a thoroughly practical system of gas illumination, but one attested by the results of years of practical experience, and its capabilities are well known to many railroad managers.

THE FROST DRY CARBURETTER SYSTEM

NEEDS NO EXPENSIVE CHARGING PLANTS TO OPERATE IT, nor is it necessary for cars to be shifted to certain points for that purpose AS IS REQUIRED BY THE SYSTEMS OF COMPRESSED COAL GAS, COMPRESSED OIL GAS AND ELECTRICITY. By adopting this system, the great advantage is gained of having all cars equipped alike, as it then makes no difference whether the cars run on the main lines or branches, or, in fact, in any part of the country, as they can be cared for at any point, by simply taking the precaution to have an empty charging can on each car, gasoline being easily procurable at almost any place. IT IS SIMPLY IMPOSSIBLE TO PUT THIS ADVANTAGE INTO MONEY VALUE, AND WE ARE SURE THAT EVERY PRACTICAL RAILROAD MANAGER WILL AT ONCE SEE THAT IT ENABLES HIM TO GET GREATER RESULTS OUT OF THE SAME EQUIPMENT THAN IT OTHERWISE WOULD IF THE CARS WERE NECESSARILY RESTRICTED TO A STATIONARY PLANT FOR THEIR LIGHT.

THE FROST DRY CARBURETTER SYSTEM

is in actual service on several railroads, principally on the Pennsylvania Railroad, which, after a thorough investigation and practical test, has decided to light its entire equipment with this as its standard system.

THE FROST DRY CARBURETTER SYSTEM

will recommend itself at once to practical railroad managers on account of its durability, simplicity, efficiency and economy.

Each carburetter has a burning capacity of one hundred and twenty-five (125) hours, but the indicator is set for one hundred and twenty (120) hours; however, the carburetter will burn one hundred and twenty-five (125) hours, if necessary, without recharging, OR UNTIL IT IS TOTALLY EXHAUSTED.

EACH BURNER GIVES FORTY (40) CANDLE-POWER LIGHT.

AFTER TWO YEARS OF ACTUAL SERVICE, we find the cost of maintaining a car equipped with six lights, IS THREE (3) CENTS PER HOUR. This provides for every possible expense that can enter into and include the term "maintenance."

The long duration of the light will enable a car to pass over the longest run several times without recharging; in fact, to more clearly demonstrate the life of the light, A TRAIN OF CARS CAN BE RUN FROM NEW YORK TO SAN FRANCISCO *AND RETURN,* WITHOUT RECHARGING THE CARBURETTERS.

COMPARISON

OF THE

COST OF MAINTAINING

AND THE

RELATIVE CANDLE-POWER ILLUMINATION

OF THE

FIVE PRESENT SYSTEMS

OF

CAR LIGHTING.

KEROSENE.

It is estimated that lighting cars with KEROSENE costs about SIX (6) CENTS PER CAR PER HOUR. This provides for six lamps, which give, *on an average,* a total of about thirty-five (35) candle-power, which, in a fifty-foot car, gives insufficient illumination.

COMPRESSED COAL GAS.

It is estimated that lighting cars with COMPRESSED COAL GAS costs about NINE (9) CENTS PER CAR PER HOUR. This provides for six lights, which give, *on an average,* a total of about sixty (60) candle-power, which, in a fifty-foot car, gives insufficient illumination.

COMPRESSED OIL GAS.

It is estimated that lighting cars with COMPRESSED OIL GAS costs about FIVE (5) CENTS PER CAR PER HOUR. This provides for five lights, which give a total of about one hundred and fifty (150) candle-power, which, in a fifty-foot car, gives a fair illumination.

ELECTRICITY.

It is estimated that lighting cars with ELECTRICITY costs about EIGHTY (80) CENTS PER CAR PER HOUR. This provides for TEN LIGHTS, which give, *on an average,* a total of about one hundred (100) candle-power, which, in a fifty-foot car, gives insufficient illumination.

FROST DRY CARBURETTER.

EXACT RECORDS SHOW that lighting cars with the FROST DRY CARBURETTER SYSTEM COSTS THREE (3) CENTS PER CAR PER HOUR. This provides for six lights, which give a total of TWO HUNDRED AND FORTY (240) CANDLE-POWER, which, in a fifty-foot car, gives a most brilliant and satisfactory light. This cost is based on gasoline at seventeen (17) cents per gallon. (The price varies from thirteen (13) to twenty (20) cents. Of course, the cheaper the gasoline, [NOT QUALITY] the cheaper the cost of the light, and *vice versa.*)

For a general system of car lighting, the Frost Dry Carburetter System is the cheapest and best known up to the present time, and it will more than hold its own against every other mode of lighting. The cost of equipping a car with the Frost Dry Carburetter System, seems, at first sight, to be excessive; but it is not to be expected that a satisfactory light can be obtained on moving vehicles at the same price as in houses and other buildings, and the nominal cost of maintenance is something astonishing. The first cost of equipping a car is comparatively small, when the great advantage arising from the ability to obtain a light which will burn at least one hundred and twenty-five (125) hours without attention, is considered; and the economy due to the less frequent moving of cars is most striking, especially at crowded terminals, where every additional train movement causes considerable trouble and embarrassment.

The difference in the cost of the equipment for the Frost Dry Carburetter System, as compared with the Kerosene and Compressed Coal Gas Systems, WILL BE SAVED IN ONE YEAR, BY THE ECONOMY IN MAINTAINING THE FROST SYSTEM. (Oil Gas and Electricity not being marketable commodities, must be made by the Railroad desiring their use. This, of course, necessitates the construction of gas works, compressing plants and charging stations, and they are therefore entirely out of this comparison, OWING TO THE EXTRAORDINARY EXPENSE FOR THE PLANTS OFF THE CAR, AND THE COST OF MAINTAINING THE SAME.) For approximately the same amount of money for equipping a car, the Frost Dry Carburetter system will give four hundred (400) per cent. more light between chargings than the Compressed Oil Gas System. It would be simply a waste of time and space to further discuss electricity. So, as a comparison with the other systems of car lighting, Kerosene, Compressed Coal Gas, Compressed Oil Gas and Electricity,—the advantages, *in every sense,* are all in favor of the FROST DRY CARBURETTER SYSTEM.

These facts demonstrate about as follows: that the FROST DRY CARBURETTER SYSTEM gives six hundred (600) per cent. more light and is one hundred (100) per cent. cheaper than lighting with KEROSENE; gives three hundred (300) per cent. more light and is two hundred (200) per cent. cheaper than lighting with COMPRESSED COAL GAS; gives fifty (50) per cent. more light, and is one hundred (100) per cent. cheaper than lighting with COMPRESSED OIL GAS; gives three hundred (300) per cent. more light and is fifteen hundred (1500) per cent. cheaper than lighting with ELECTRICITY; that there is no light, for lighting passenger and other railroad cars, at the present time, that can compete with it in any sense whatever; and we feel confident that practical railroad managers will at once see the great benefit to be gained by the prompt adoption of the FROST DRY CARBURETTER SYSTEM.

SPECIAL NOTICE.

THE FROST DRY CARBURETTER SYSTEM

HAS BEEN APPROVED

BY THE

PHILADELPHIA AND NEW YORK

BOARDS OF FIRE UNDERWRITERS.

COMPARISON

OF THE

NUMBER OF CUBIC FEET

OF

GAS CARRIED UNDER COMPRESSION

AND

AT WHAT PRESSURE PER SQUARE INCH COMPRESSED,

ALSO

THE NUMBER OF HOURS OF LIGHT BETWEEN CHARGINGS

OF THE

THREE PRESENT GAS SYSTEMS.

COMPRESSED COAL GAS.

It is estimated that the Compressed Coal Gas System carries about THREE HUNDRED (300) CUBIC FEET OF GAS, compressed to about TWO HUNDRED AND TWENTY-FIVE (225) POUNDS PRESSURE PER SQUARE INCH, and gives about TEN (10) HOURS LIGHT BETWEEN CHARGINGS. (Fully fifty [50] per cent. of the illuminating power is lost by compression at this pressure.)

COMPRESSED OIL GAS.

It is estimated that the Compressed Oil Gas System carries about FOUR HUNDRED (400) CUBIC FEET OF GAS, compressed to about FIVE HUNDRED (500) POUNDS PRESSURE PER SQUARE INCH, and gives about TWENTY-FIVE (25) HOURS LIGHT BETWEEN CHARGINGS.

FROST DRY CARBURETTER.

The Frost Dry Carburetter System carries about TWO (2) CUBIC FEET OF GAS TO EACH CARBURETTER, or a total of TWELVE (12) CUBIC FEET PER CAR, under THREE (3) POUNDS PRESSURE PER SQUARE INCH IN CARBURETTER, and gives ONE HUNDRED AND TWENTY-FIVE (125) HOURS LIGHT BETWEEN CHARGINGS. With the Frost Dry Carburetter System there is absolutely nothing under high pressure, consequently there is no severe strain at any time on any part of the same that can cause any trouble whatever, and when the lights are not burning, all pressure is cut off from the Carburetters. Should a wreck occur, and the Carburetters be displaced, they are made of such flexible material (copper), that they will stand any amount of distortion without rupture; still further, the gasoline is absorbed in wicking in such a way that although every cock on the Carburetter be opened, no liquid runs out or can run out.

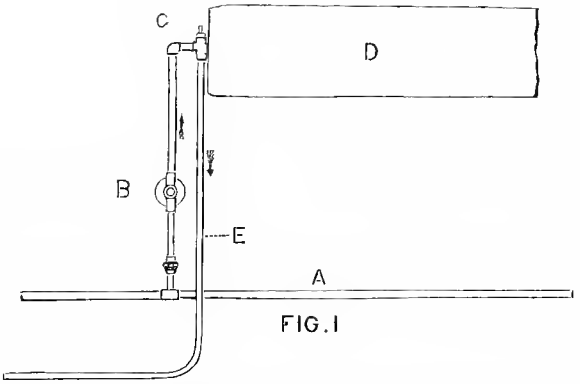

FIG. 1

TRAIN PIPE, CHECK VALVE, DUST SCREEN AND AIR-STORAGE RESERVOIR.

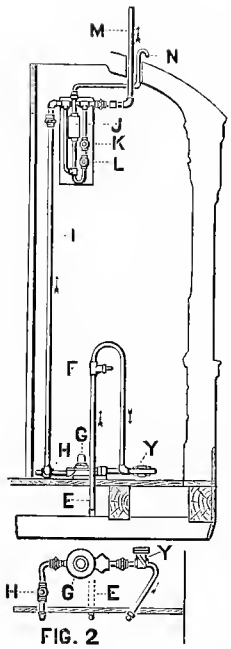

FIG. 2

"CHAPMAN" REGULATOR, INDICATOR, SAFETY VALVE AND CLOSET VALVE.

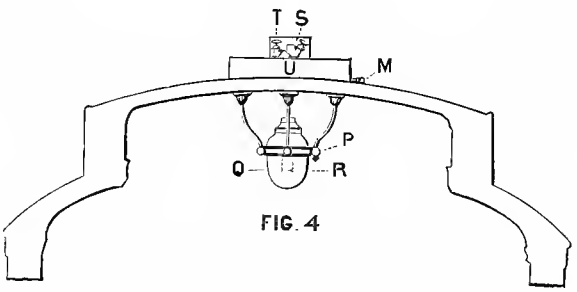

FIG. 4

CARBURETTER AND LAMP.

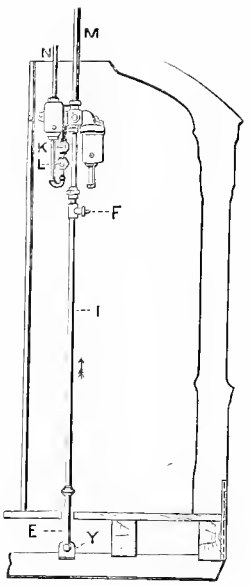

FIG. 3.

"BOWMAN" REGULATOR, INDICATOR, SAFETY VALVE AND CLOSET VALVE.

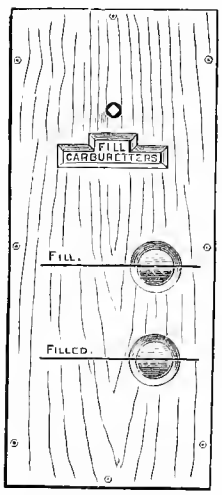

FIG. 8.

INDICATOR BOX LID.

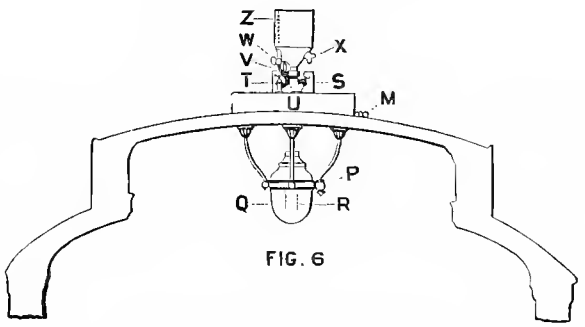

FIG. 6

CHARGING CAN IN POSITION.

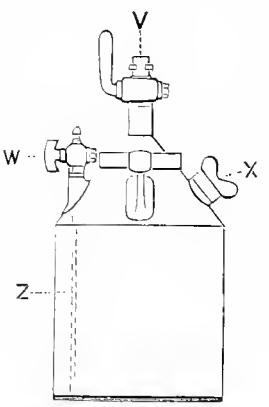

FIG. 5.

CHARGING CAN.

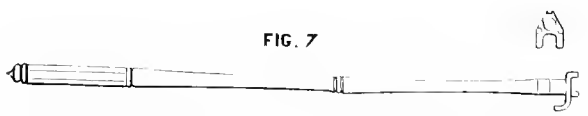

FIG. 7

COMBINED VENTILATOR HOOK AND NEEDLE VALVE KEY.

INSTRUCTIONS FOR MANIPULATING.

TO LIGHT UP A CAR.

I. SEE THAT ALL VALVES **P** [Figure 4] ON THE LAMPS ARE CLOSED. Open the closet valve **F** [Figure 2 or Figure 3] SLOWLY two or three turns. Then light the lamps ONE AT A TIME, as follows: Let down the clear glass bowl **Q** [Figure 4] and RAISE THE CHIMNEY, then open the valve **P** [Figure 4] one-sixth [1-6] of a turn, applying a lighted match AT THE TOP OF THE BURNER at the same time; replace the chimney, close the clear glass bowl and adjust the flame about one [1] inch high. When carburetters have become warmed somewhat, turn the flame up higher. It is quite essential that the lamps should all be burned alike. IF LESS LIGHT IS DESIRED, TURN DOWN ALL THE LIGHTS; IF MORE LIGHT IS WANTED, TURN THEM ALL UP.

TO PUT OUT THE LIGHTS.

II. Close the closet valve **F** [Figure 2 or Figure 3] TIGHTLY, then close TIGHTLY valve **P** [Figure 4] on each lamp. KEEP THE VALVE ON LAMPS ALWAYS CLOSED WHEN THE LIGHTS ARE NOT BURNING.

TO TELL WHEN THE CARBURETTERS NEED RECHARGING.

III. Have all lights burning full for at least one hour, then observe the indicator **KL** [Figure 2 or Figure 3] in closet; if the mercury covers one-half of the upper sight glass **K**, the carburetters must be recharged. The trainmen should observe the indicator at the end of each trip, when the lights are in use, and if the carburetters need recharging turn the disc on the Indicator box lid [Figure 8] with the valve wrench until the words "FILL CARBURETTERS" appear. The Inspectors or others who have charge of filling the carburetters should look in the closet to see whether the notice shows "Fill carburetters," and if it does they should be filled, and after this is done THE DISC SHOULD BE TURNED BACK TO ITS NORMAL POSITION, SHOWING BLANK AT THE OPENING.

TO CHARGE THE CARBURETTERS.

IV. See that all valves **P** [Figure 4] on the lamps are closed tightly. OPEN CLOSET VALVE **F** [Figure 2 or Figure 3] SO AS TO ADMIT FULL AIR PRESSURE TO CARBURETTERS. The charging can (Figure 5) with all cocks closed is put bottom upward in the charging valve **S** on top of the carburetter, as shown in Figure 6. A slight turn to the right holds it in position and makes a gas-tight joint between can and carburetter; slip the rubber hose attached to the can over the nipple on discharge valve **T** on carburretter. Open the discharge valve **T** and the cock **W** on can, which are connected by the rubber hose, then open the charging valve **S** on carburetter and finally cock **V** on the can; the gasoline then flows into the carburetter and the gas in the carburetter passes through the hose into the can in place of the gasoline. When carburetters need recharging, usually a can full or two (2) gallons will run in. The can should be allowed to remain in position from five (5) to ten (10) minutes, and it is not necessary to stand by it. With a sufficient supply of cans the carburetters may be charged as fast as the cans are put in position, and usually by the time the last carburetter is fitted with its can the first one is ready to be taken off.

TO REMOVE CHARGING CANS FROM CARBURETTERS.

V. First, close the cock **V** on the can, then close the charging valve **S** on the carburetter; next, detach the can without interfering with the hose. Turn the can right side up and slightly open cock **V**; this allows the pressure to escape from the can; and if the carburetter has been overcharged the gasoline is blown back from the carburetter through the hose into the can. If the carburetter refuses to take gasoline when the can is arranged as described, close all cocks and valves, detach rubber hose from the discharge valve on the carburetter and open this valve SLOWLY. If gasoline appears, [not a few drops] it shows that the carburetter does not need charging. If only gas appears, allow it to escape for a few seconds then close the valve and open cock **W** to which hose is attached on the can and allow any gasoline in the hose or in the tube inside of the can to escape; then connect up the hose and proceed in the usual way. LASTLY, CLOSE CLOSET VALVE **F** [Figure 2 or Figure 3] IN CLOSET, AND TURN THE DISC "FILL CARBURETTERS" TO ITS NORMAL POSITION, SHOWING BLANK AT THE OPENING.

GENERAL DESCRIPTION.

In this system the light is produced by burning in the lamps a gas generated in the carburetters, which are placed on the top of the car. The gas is simply air carrying a certain amount of gasoline vapor. The air is taken from the air-brake service, the gasoline, absorbed in wicking, is contained in the carburetters, and the object of the appliances is to bring these two substances together, vaporize the gasoline, and thus produce the gas.

The following is a description of each of the parts in detail:—

I. TRAIN PIPE, CHECK VALVE, DUST SCREEN AND AIR-STORAGE RESERVOIR.

Commencing underneath the car (Figure 1), air is taken from the train pipe **A** into a cylinder **D** which serves as an air-storage reservoir. Between the train pipe and the storage reservoir is the check valve and dust screen **B.** The dust screen prevents anything in the air from getting into the check valve and beyond it. The check valve opens toward the storage reservoir, so that when the pressure in the train pipe is greater than the pressure in the storage reservoir, the air passes from the train pipe into the storage reservoir. When from any cause, as when the air brakes are being applied, the pressure in the train pipe is less than the pressure in the storage reservoir, the check valve closes and retains the air already in the storage reservoir. In addition to furnishing a storage supply, the cylinder containing the air prevents fluctuations in the light, which would result if the air was taken directly from the train pipe to the carburetter. The capacity of the storage reservoir is such, that with sixty (60) pounds pressure in the air-brake service, the air storage on each car will furnish light for the car six (6) hours after the car is detached from the train, the variation in the length of time being due to the amount of gasoline in the carburetters. The check valve and dust screen are put in order when the car leaves the shop: they should be cleaned at least once in three months and perhaps more frequently. The air-storage reservoir is provided with a valve **C** at one end, which valve is normally open, and should only be closed when from any cause it is necessary to shut off the air supply from the closet. The same wrench that is used in the car to operate the closet valve is used for operating this valve. From the storage reservoir a pipe **E** conducts the air up into the closet. In this pipe is also placed a dust guard **Y** (Figure 2 and Figure 3) for additional security against anything passing with the air from the storage reservoir into the regulator, indicator or safety valve, in the closet.

II. REGULATOR, INDICATOR, SAFETY VALVE, CLOSET VALVE AND INDICATOR BOX LID.

In the closet (Figure 2), the first thing on the pipe **E** from the storage reservoir, is the closet valve **F.** This valve controls the connection between the reservoir and carburetters. When it is open, air passes into the carburetters. When it is closed, the air is cut off from the carburetters. The valve is operated with the ordinary valve wrench, and it should be opened slowly in order to prevent a violent fluctuation of the mercury in the indicator. Beyond the closet valve, the cars are fitted up in two ways depending upon the kind of regulator used.

If the CHAPMAN REGULATOR **G** is used, the pipe carrying the air passes from the closet valve **F** down to the floor and through the partition to the short seat outside of the closet. Under this seat are located, first, a dust guard **Y** as additional security; second, the Chapman regulator **G**; third, the check valve **H.** The regulator reduces the pressure, so that while on the side of the regulator toward the storage reservoir the pressure may be 60 or 70 or even 80 pounds, beyond the regulator toward the carburetters, the pressure is normally three (3) pounds. The regulator **G** is set in the shop, and in general should not be touched in service. The object of the check valve **H** beyond the regulator is to prevent any gasoline vapor coming back from the carburetters and affecting the diaphragm of the regulator. From the check valve the air passes back through the partition into the closet and up through the pipe **I** to the safety valve and indicator **J K L**, which are combined in one piece of mechanism. The object of the safety valve **J** is to prevent any over-pressure in the carburetters, and this is accomplished by a mercurial seal of such height that whenever the pressure in the carburetters exceeds four (4) pounds per square inch, the mercurial seal is broken and the pressure relieved through the waste pipe **N** to the atmosphere. The object of the indicator **K L** is to show when the carburetters need recharging. It has been found that as the gasoline in the carburetters approaches exhaustion the quantity of air necessary to produce the light increases, and it is upon this principle that the indicator is constructed. A diaphragm with a small hole in it is put in the main passage-way and all the air that goes to the carburetters passes through this hole. What is practically the U tube, containing mercury, has one leg of the U connected with the main passage-way between the diaphragm and carburetters, and the other leg to the blow-off chamber, which is in communication with the atmosphere through pipe **M**. When no air is passing to the carburetters the mercury level in both tubes of the U is undisturbed, but when any air passes through the diaphragm the mercury level changes in proportion to the difference in pressure between that in the pipe leading to the carburetters and that in the opposite leg, due to the pressure of the atmosphere. When the carburetters are fully charged and all lights are burning the mercury appears only in the sight glass **L** but when the mercury level is changed so that it appears in and covers about one half (½) of the sight glass **K** with all lights burning, the carburetters should be recharged. It is best to

observe the indicator after the lights have been burning for at least an hour, for the reason that when the lamps are first lighted the carburetters are cold, and consequently use more air than they do after they have become warm. If the indicator is read immediately after the lamps are lighted, the carburetters will probably be filled sooner than is required. The trainmen should observe the indicator at the end of each trip, when the lights are in use, and if the carburetters need recharging turn the disc on the indicator box lid (Figure 8) with the valve wrench until the words "Fill carburetters" appear.

The Inspectors or others who have charge of filling the carburetters should look in the closet to see whether the notice shows "Fill carburetters," and if it does they should be filled, and after this is done the disc should be turned back to its normal position, showing blank at the opening on the indicator box lid. From the indicator and safety valve the pipe **M** carrying the air extends through the roof to the carburetters.

If the BOWMAN REGULATOR is used (Figure 3, Plate K), the dust guard **Y** is placed outside of the car, and the Regulator, Indicator and Safety Valve are combined in one piece of mechanism. This device involves in its construction the same principles as are used in the Regulator, Indicator and Safety Valve previously described; but the Regulator, instead of being constructed with a diaphragm and spring, as in the case of the Chapman Regulator, is made to open and close as the air pressure varies on the mercury in the cup of the apparatus. This combined Regulator, Indicator and Safety Valve, is placed in the closet above the closet valve **F** and from it the pipe **M** carrying the air extends through the roof to the carburetters.

III. CARBURETTERS.

The air pipe **M** (Figure 4), after extending through the roof, runs along nearly the whole length of the car and has a branch leading to each carburetter taking the air into them.

The carburetter **U** is a round flat box with a hole in the centre and having within it a spiral chamber about forty (40) feet long, which spiral chamber is filled with cotton wicking. The air inlet to the carburetter is near the centre hole; the outlet is near the edge. The air which is to pass into the carburetter is taken through a small copper pipe, which is bent in the form of a conical spiral and placed in the flue of the carburetter directly above the lamp. The object of this spiral coil is to heat the air before it enters the carburetter by the combustion from the lamp, and in this way to furnish the heat that is necessary to vaporize the gasoline and generate the gas. As a further means of furnishing heat to the carburetter, it is surrounded with an air space, which communicates with the inside of the car, so that warm air from the car constantly passes around the outside of the carburetter and out through the ventilator. Both the ventilator and the cover of the mantle which form the visible outside portion of this warm air space are detachable and may be taken off as occasion requires. When the carburetters are freshly charged, or when the air is very warm, there is a possibility of carrying too rich a gas down to the lamps; to obviate this difficulty a permanent cross connection is made between the air inlet to and the outlet from the carburetter. In this cross connection is a diaphragm with a very small hole, so that a small amount of air is taken across to the gas as it comes out of the carburetter, diluting it a little, and thus preventing any possibility of too rich or smoky a gas reaching the lamp.

IV. LAMPS.

From the carburetter, **U** (Figure 4), the gas passes down through one of the arms of the lamp to the burner. Each lamp is provided with a needle valve **P** to regulate and shut off the supply of gas, and this valve is provided with a locking device, so that it cannot be opened until the clear glass bowl **Q**, surrounding the burner, is lowered. The air to support the flame is taken in at the top of the lamp and passes down beside the chimney, by which means it is heated somewhat, so that to a certain extent, the lamp is regenerative. To light a lamp it is necessary to open the clear glass bowl **Q**, raise the chimney **R**, open the needle valve **P** about one-sixth (1-6) of a turn, which will usually furnish sufficient gas for lighting, and apply a lighted match at the top of the burner, then replace the chimney and close the clear glass bowl. It is advisable in lighting up not to start with a flame more than one (1) inch high, as the flame increases as the carburetter becomes warm.

IT IS QUITE ESSENTIAL THAT THE LAMPS SHOULD ALL BE BURNED ALIKE. If one lamp is burned with a higher flame than another, THE GENERAL APPEARANCE OF THE CAR IS GREATLY MARRED, or, if some of the lamps are burned and others are not, when the car comes to be recharged, some of the carburetters will require more gasoline, since from some of them more gasoline has been burned than from others. It is in every sense better to have the flames in all the lamps as nearly as possible the same height at all times. IF LESS LIGHT IS DESIRED, TURN DOWN ALL THE LIGHTS; IF MORE IS WANTED, TURN THEM ALL UP.

When the lights in a car are to be put out the closet valve **F** (Figure 2 or Figure 3) should be closed; THEN CLOSE THE NEEDLE VALVE **P** (Figure 4) ON EACH LAMP.

V. CHARGING VALVE, DISCHARGE VALVE AND CHARGING CAN.

On the top of the carburetter by the side of the ventilator (Figure 4), are located the charging valve **S** and discharge valve **T.** These valves are used to charge the carburetter. The carburetter being closed tight and filled with gas at all times, nothing will run in unless some provision is made for a corresponding amount of gas to run out, and to permit this is the object of the discharge valve **T**, which is fitted with a hose nipple. The charging valve **S** is to receive the spout of the charging can.

The charging can (Figure 5) holds about two (2) gallons and is provided with three openings **V W X.** The opening **X** is closed with a screw plug which is removed when the can is to be filled. The openings **V** and **W** are closed by means of plug cocks.

VI. CHARGING CARBURETTERS.

In charging the carburetter all openings in the charging can are first closed; the can is then turned bottom upward (Figure 6) and the central opening **V** is inserted in the charging valve **S** on the carburetter, a slight turn to the right is given to the can by which it is held in position and a gas-tight connection made with the carburetter. A short piece of rubber hose is then slipped over the hose nozzles **T** and **W**, on the carburetter, discharge valve and can respectively. The discharge valve **T** on carburetter is then opened, next the cock **W** on the can, then the charging valve **S** on the carburetter, and finally the cock **V** on the can. The gasoline flows down through the cock **V** and valve **S** into the carburetter and the gas in the carburetter passes up through the valve **T**, the rubber hose, the cock **W** and the small pipe **Z** into what is now the top of the can, above the gasoline, replacing the latter as it flows out of the can.

The arrangement of the pipes inside the carburetter is such that when it is fully charged no more gasoline passes in, provided the closet valve **F** is open, admitting full air pressure, although it may not have completely run out of the can. When carburetters are sufficiently exhausted so that they really need recharging, they should, however, take the full two (2) gallons which the can holds. It may happen sometimes from the failure of the arrangements to prevent overcharging of the carburetters, that more gasoline gets into them than they should have. To obviate this difficulty it is essential in all cases to proceed as follows when taking the charging can from the carburetters: first, close the cock **V** on the can; second, close the charging valve **S** on the carburetter. Then detach the can, taking care not to interfere with the hose. Turn the can right side up, and slightly open the cock **V.** The can has the same pressure in it that the carburetter has and consequently there will be a rush of gas out of this cock. The connection between the carburetter and the charging can being open through the rubber hose, if there is any excess of gasoline in the carburetter it will now be blown out through the hose into the can. As soon as the gas begins to come into the can, which is indicated by a bubbling noise in the can if any gasoline is there, close the discharge valve **T** on the carburetter, and then close the cock **W** fitted with the nipple on the can. The rubber hose can then be detached.

VII. COMBINED VENTILATOR HOOK AND NEEDLE VALVE KEY.

A rod (Figure 7) for operating the needle valve on lamps and for opening and closing the deck ventilators is also necessary. This rod is made with a brass tip which fits the small wheel on the needle valve, and the cross bar on the deck sash opener. One of these rods should be furnished for each car.

When the carburetters are fully charged, they will burn one hundred and twenty-five (125) hours, excepting the first charging. The charging of carburetters, therefore, will not be very frequent, varying from about once in twelve (12) days in winter to a much longer time in summer. This long service from one charging makes it unnecessary to carry a large stock of gasoline.

THE QUALITY OF GASOLINE REQUIRED IS THAT KNOWN IN THE MARKET AS 88° GRAVITY.

LIST

OF THE DIFFERENT PARTS OF THE

FROST DRY CARBURETTER SYSTEM

NECESSARY FOR THE EQUIPMENT OF A CAR

WITH ONE LIGHT.

One Carburetter, Complete,
One Air Tank,
One Lamp,
One Regulator, Indicator and Safety-valve,
One Closet Needle Valve,
One Tank Needle Valve,
One Combined Dust Screen and Check Valve,
Four Brass Unions, $\frac{1}{2}$ inch,
One Brass Ell, $\frac{1}{2}$ x $\frac{1}{8}$,
Four Brass Ells, $\frac{1}{2}$ inch,
One Combined Ventilator Hook and Needle-Valve Key,
One Valve Wrench,
One Indicator Board,
One Charging Can,
Copper Tubing to suit length of car.

FOR EACH ADDITIONAL LIGHT

THE PARTS WOULD BE:—

One Carburetter, Complete,

One Lamp,

One Brass Tee, $\frac{1}{2}$ x $\frac{1}{8}$,

and as many Charging Cans as are deemed necessary.

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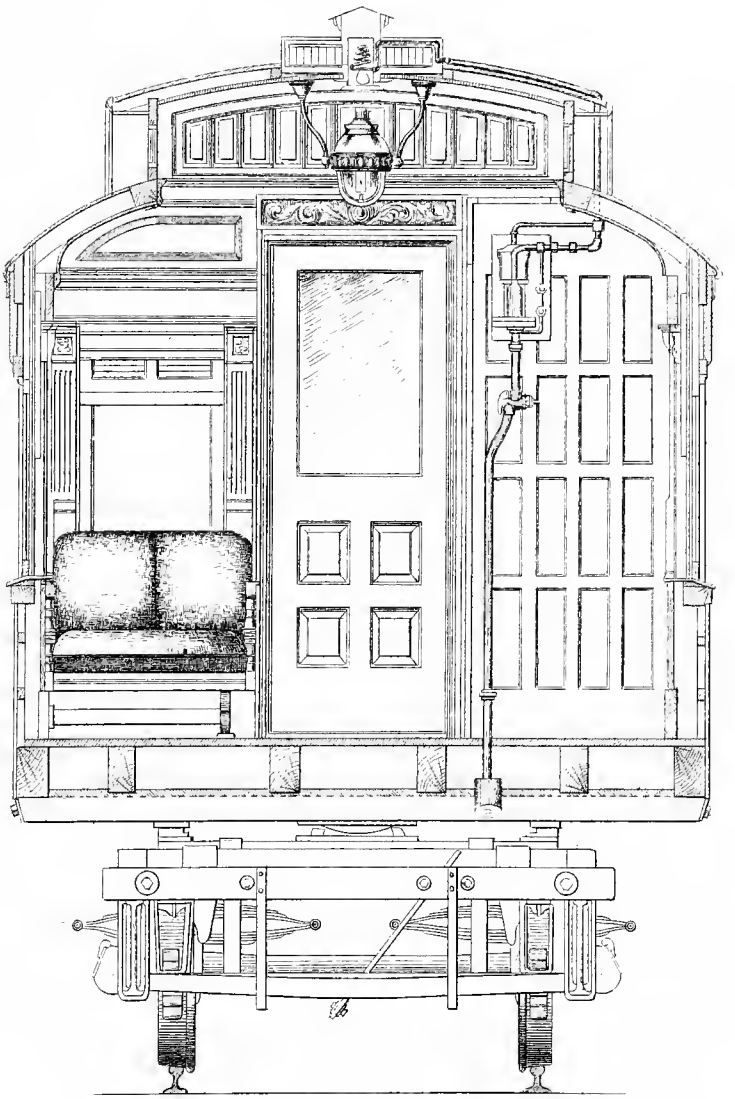
FROST DRY CARBURETTER SYSTEM.

ARRANGEMENT OF CLOSET VALVE, REGULATOR, INDICATOR AND SAFETY VALVE IN CLOSET.

PLATE B.

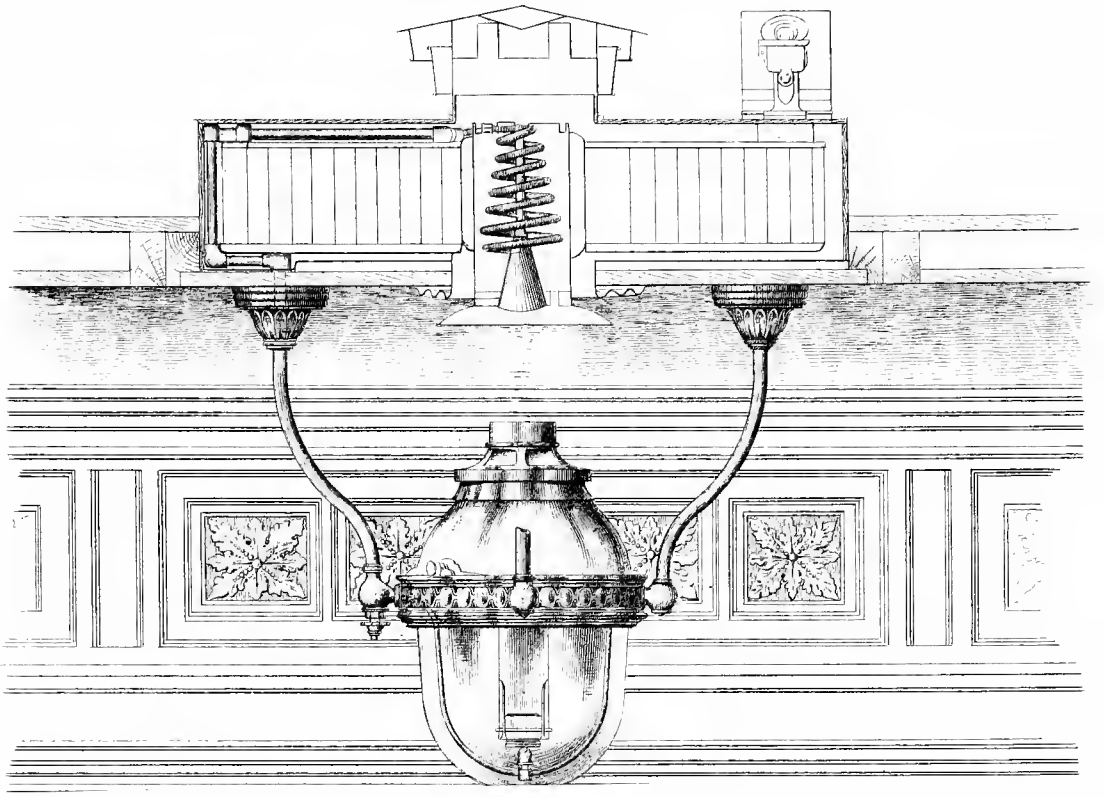


PATENTED.

FROST DRY CARBURETTER SYSTEM.

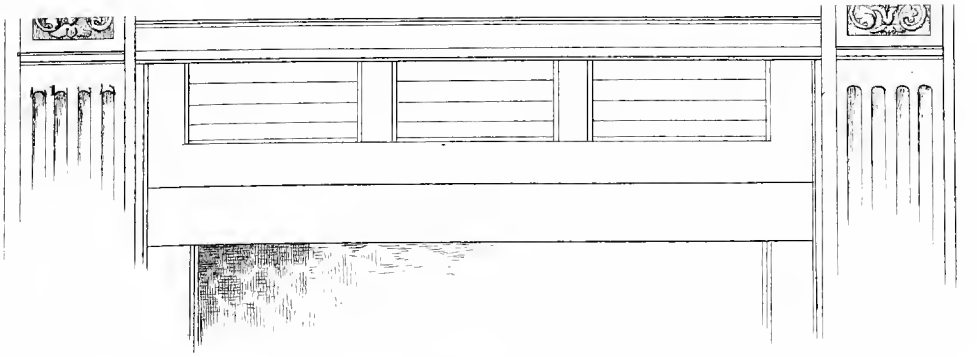
SECTIONAL VIEW, SHOWING POSITION OF LAMP AND CARBURETTER IN CAR.

PLATE C.



GENERAL NOTICE.

To distinguish the Frost Dry Carburetter System from the Compressed Coal Gas System, a copper coil can be seen in the ventilator from the inside of the car, which is not used with the Compressed Coal Gas System. This information is given for those unacquainted with the Frost Dry Carburetter System that they may not do it an injustice, as some railroads have our lamps burning Compressed Coal Gas, preparatory to equipping with the Carburetter System.

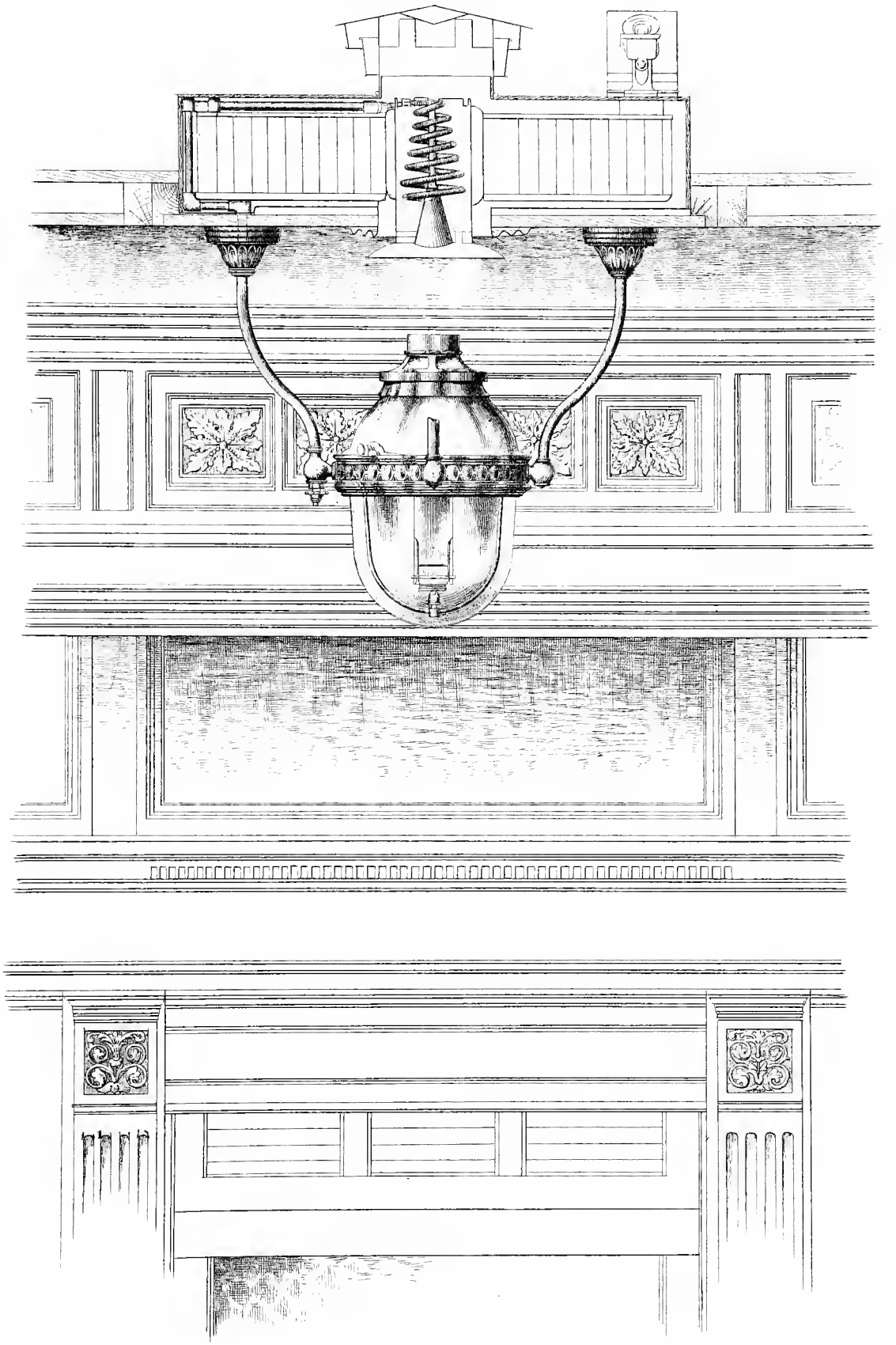


PATENTED.

FROST DRY CARBURETTER SYSTEM.

SECTIONAL VIEW, SHOWING POSITION OF LAMP AND CARBURETTER IN CAR.

PLATE C.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

DECK LAMP, COMBINED VENTILATOR HOOK AND NEEDLE VALVE KEY.

PLATE D.

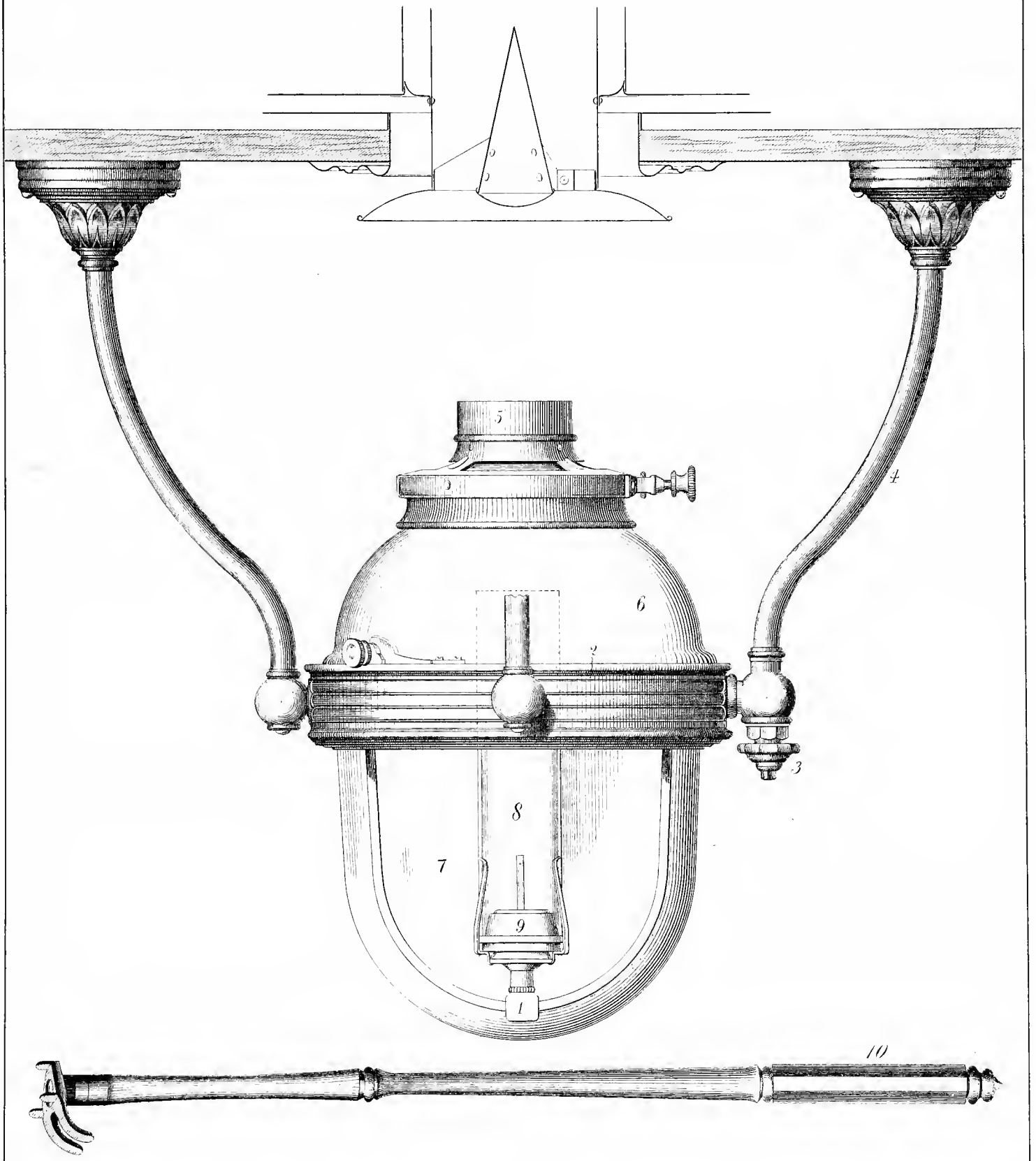
Bow for Supporting Lamp Burner,	1
Band on Body of Lamp,	2
Needle Valve,	3
Gas Arm,	4
Top Cap and Chimney Holder,	5
Porcelain Shade,	6
Clear Glass Bowl,	7
Glass Chimney,	8
Special Argand Burner,	9
Combined Ventilator Hook and Needle Valve Key,	10

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

DECK LAMP, COMBINED VENTILATOR HOOK AND NEEDLE VALVE KEY.

PLATE D.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

BRACKET LAMP.

PLATE E.

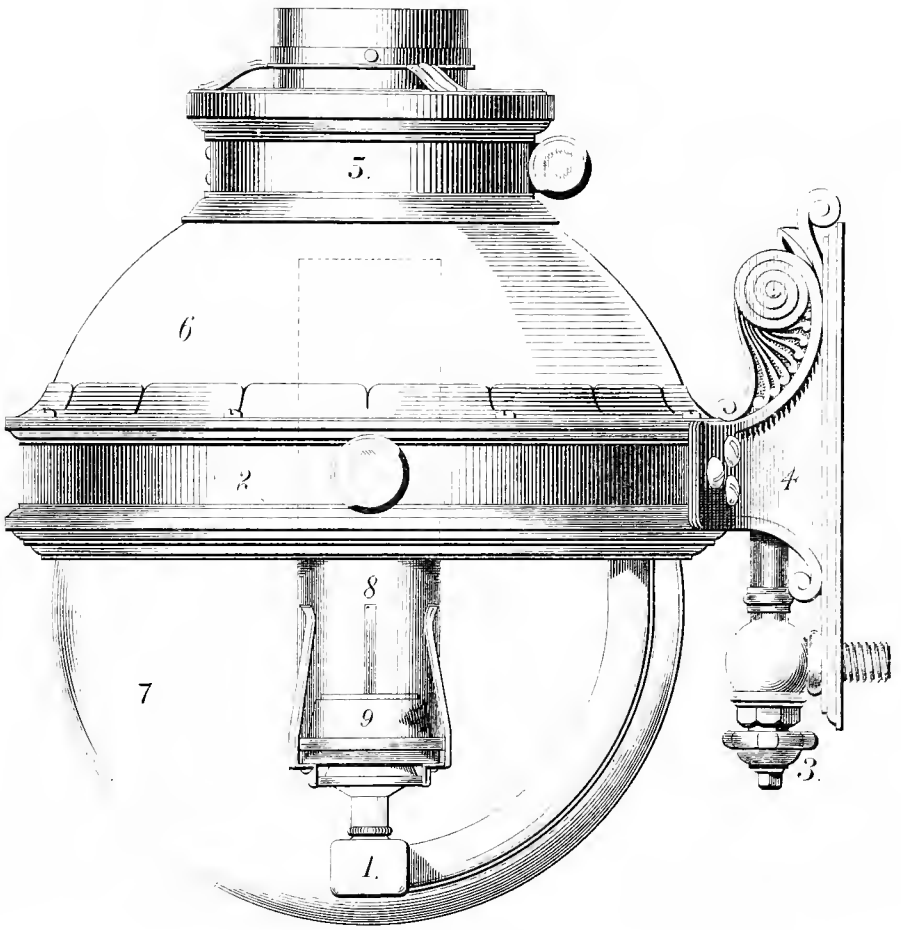
Gas Arm and Burner Support,	1
Band on Body of Lamp,	2
Needle Valve,	3
Lamp Bracket,	4
Top Cap and Chimney Holder,	5
Porcelain Shade,	6
Clear Glass Bowl,	7
Glass Chimney,	8
Special Argand Burner,	9

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

BRACKET LAMP.

PLATE E.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

SECTIONAL VIEW OF CARBURETTER.

PLATE F.

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

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FROST DRY CARBURETTER SYSTEM.

PLAN OF CARBURETTER.

PLATE G.

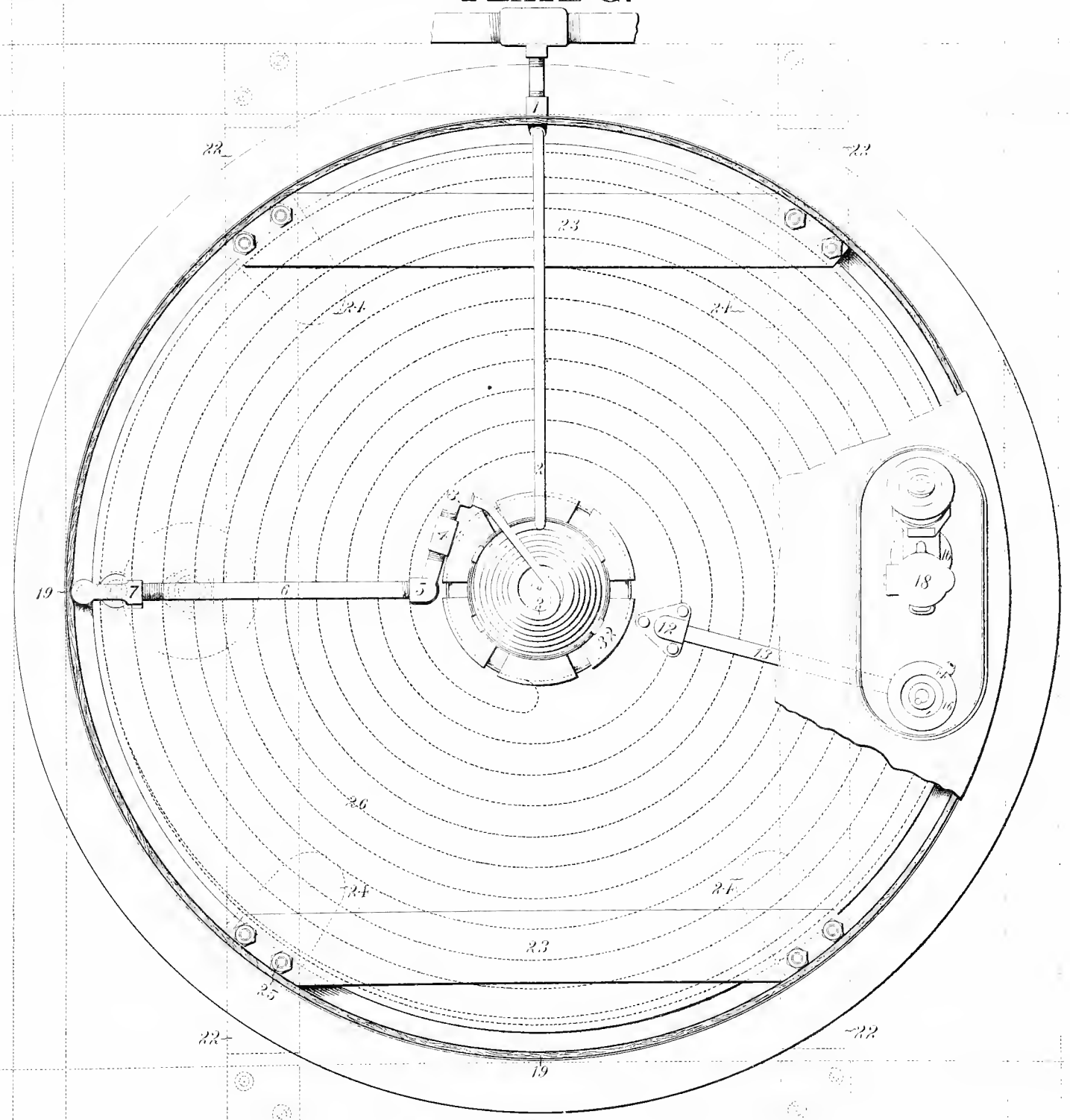
Special Brass Ell,	1
Copper Coil for Warming Air,	2
Special Brass Ell,	3
" " Sleeve,	4
" " Ell,	5
Brass Injector Pipe,	6
Special Brass Tee,	7
" " Ell,	12
" " Pipe,	13
Discharge Valve,	14
Charging "	18
Mantel,	19
Supporting Bars,	22
Top Clamps,	23
Cast Iron,	24
Clamp Bolts,	25
Spiral Passage containing Capillary,	26
Air Space around Carburetter,	27
Supporting Ring for Smoke Flue,	32

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

PLAN OF CARBURETTER.

PLATE G.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

CHARGING VALVE

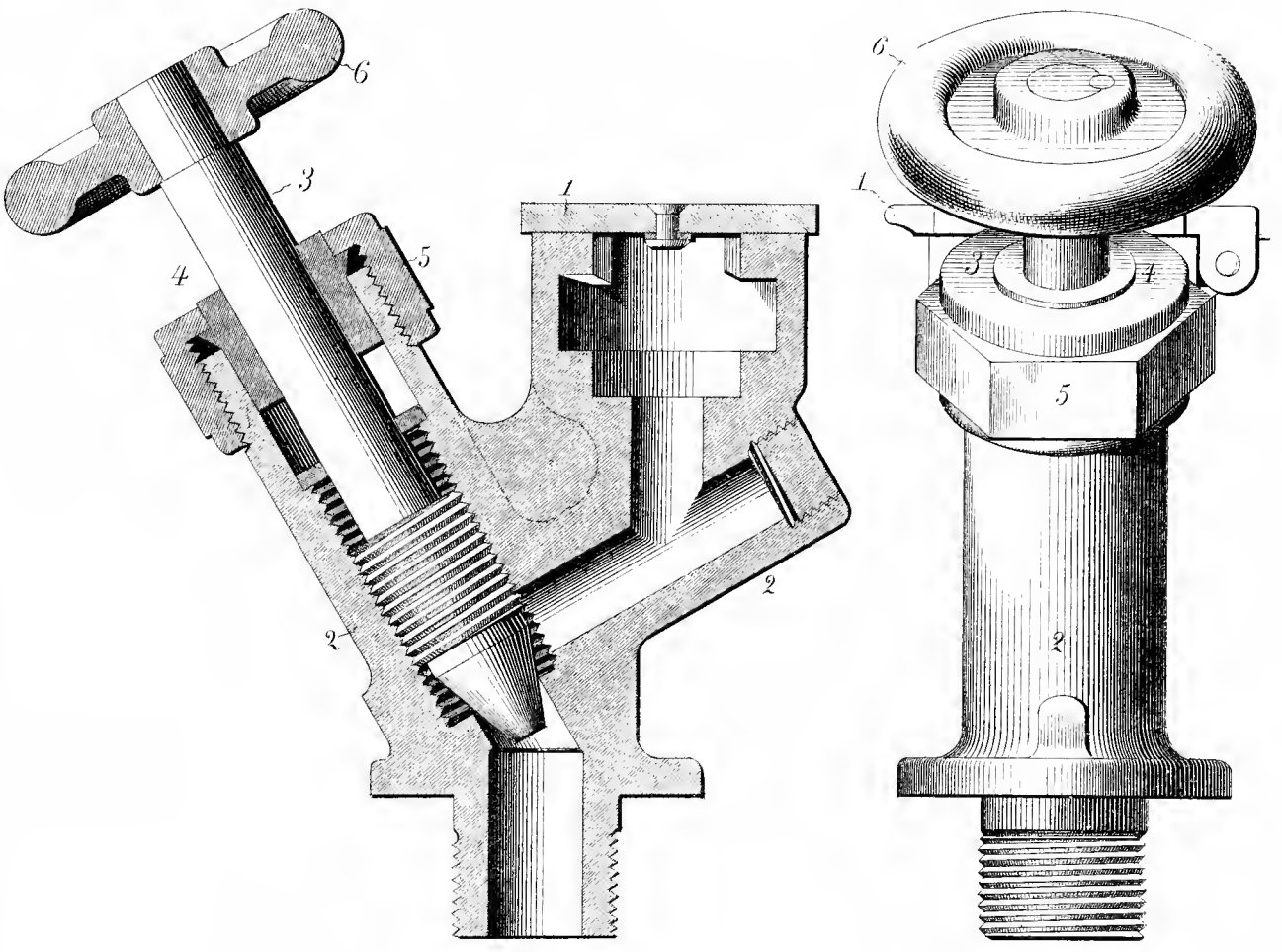
PLATE H.

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

CHARGING VALVE.

PLATE H.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

DISCHARGE VALVE.

PLATE I.

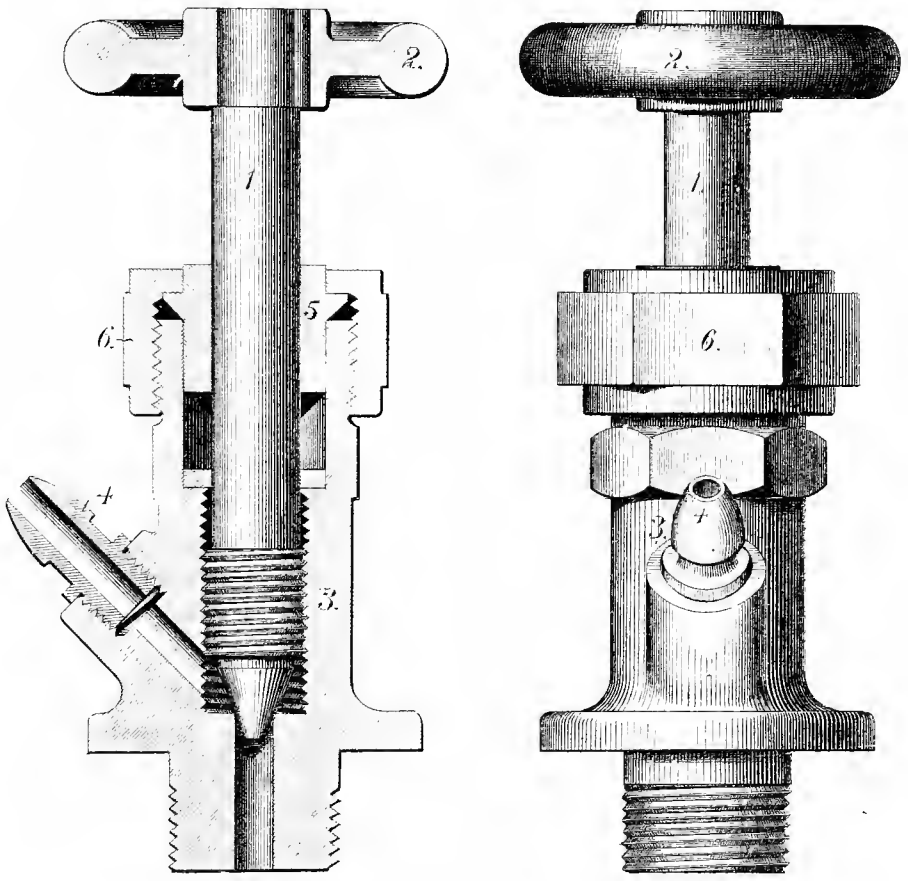
Needle,	1
Hand Wheel on Stem of Needle,	2
Body of Valve,	3
Nipple for Hose,	4
Packing Follower,	5
Packing Nut,	6

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

DISCHARGE VALVE.

PLATE I.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

BRASS PIPE FITTINGS.

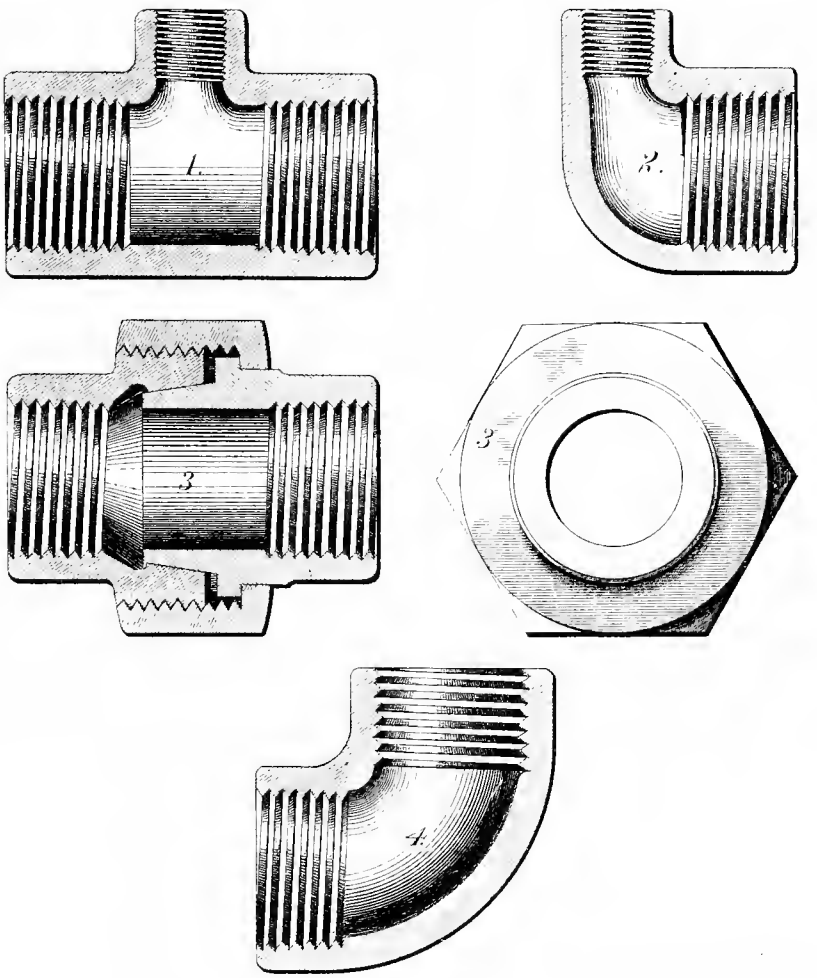
PLATE J.

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

BRASS PIPE FITTINGS.

PLATE J.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

THE BOWMAN REGULATOR, INDICATOR AND SAFETY VALVE.

PLATE K.

1 Main Casting of Regulator and Blow-off Chamber.
2 Regulator Cup.
3 Hollow Weight.
4 Steadying Pipe.
5 Pipe Covering screwed in Cup B.
6 Sight Glass Castings for Indicator.
7 Large Leg of U leading to Blow-off Chamber.
8 Deflector in Blow-off Chamber.
9 Perforated Plate for Supporting Deflector Casting.
10 Cap of Blow-off Chamber.
11 Small Pipe leading from Blow-off Chamber to Atmosphere.
12 Main Pipe leading from Reservoir to Regulator, Indicator and Safety Valve.
13 Reduced Pressure Pipe Leading from Regulator, Indicator and Safety Valve to Carburetters.
14 Plug in top of Regulating Chamber.
15 Over-flow Set Screw for Indicator located in Blow-off Chamber.
16 Over-flow Set Screw for Regulator located in Regulator Cup.
17 Plug Covering Regulator Valve and Fulcrum.
18 Return Bend for Indicator.
19 Regulator Valve.
20 Regulator Valve Seat.
21 Regulator Valve Lever.
22 Regulator Valve Links.
23 Link Plug screwed in top of Regulator Weight.
24 Perforated Diaphragm.
25 Link Pins for Regulator.
26 Valve Pin for Regulator.
27 Set Screw for Holding Deflector to Perforated Plate.
28 Plug for holding Perforated Diaphragm in place.

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

DESCRIPTION

OF THE

BOWMAN REGULATOR, INDICATOR AND SAFETY VALVE.

This device involves in its construction the same principles as are used in the Regulator, Indicator and Safety Valve, previously described; but the Regulator, instead of being constructed with a diaphragm and spring, as in the case of the Chapman Regulator, is made to open and close as the air pressure varies on mercury in the cup "2" of the apparatus. Its action is as follows:—"19" is a small valve controlling the opening through which air flows from the reservoir under the car to the chamber "1" of the Regulator; "21" is a lever holding this valve in place; "22" is a link supporting the weight "3," which keeps the valve "19" in place against pressure; "2" is a cup containing mercury for the purpose of floating the hollow weight "3." When air enters the Regulator chamber "1" it acts on the surface of the mercury surrounding the weight in cup "2," forcing it downward and through the steadying pipe "4" into the hollow centre of the weight "3," thereby losing its power of floating the weight "3," which allows the weight to fall and closes the valve "19" against any further admission of air. The quantity of mercury in the cup "2" for supporting the weight is so proportioned that when the Closet Valve in the pipe "12" is closed, and no air passing in to the apparatus, it will float the weight "3," and open the valve "19," as above described, until a pressure of three pounds per square inch is reached, when the mercury is forced up into the centre of the weight "3," which allows the weight to fall and shut off the further passage of air.

In practice, when air is passing from the chamber "1" to the Carburetters, the mercury is just held at such a point by the pressure in chamber "1," and floats the weight "3" to a height just necessary to give sufficient opening of the valve "19" and supply the demand of air. "24" is a perforated diaphragm, same as described. "28" is a plug which holds the perforated diaphragm "24" in place in the Regulator casting. "29" is a cored passage representing one leg of the mercurial "U" communicating with the passage between the perforated diaphragm "24" and the Carburetters. "6" and "6" are the sight openings through which the condition of the Carburetters is seen. "7" is a pipe forming one leg of the "U," which terminates in the blow-off chamber "8^1." "8" is a deflector casting held in the blow-off chamber by the perforated plate "9," and is for the purpose of preventing mercury from being blown out of the chamber when the blow-off is in action. "10" is the cap of the blow-off chamber "8^1," and "11" a small waste pipe leading from the blow-off chamber "8^1" to the atmosphere. "15" is an over-flow set-screw located in the side of the blow-off chamber "8^1" for the purpose of showing when enough mercury has been poured into the Indicator. "16" is a similar over-flow set-screw for the purpose of telling when enough mercury has been poured into the Regulator cup to set it to the proper pressure. The location of these set-screws is determined by actual experiment before the apparatus is turned out of the shop.

This apparatus is so arranged that if any excessive pressure is generated in the Carburetters by the heat of the sun, when the car is standing on an exposed siding, it is promptly relieved by the Indicator pipe, which forms a safety valve with the blow-off chamber "8^1" to the atmosphere, while at the same time mercury is prevented from escaping, as above described by the deflector "8".

When this apparatus is located in the closet of a car, a Closet Valve controlling the flow of air from the reservoir under the car is located in the pipe "12" immediately below it, and when this Closet Valve is closed, when the lights are not in use, the weight "3" is floated by the mercury, thereby taking all weight and wear off the parts connected with the Regulator, consequently there is no wear when the lights are not burning; and when the lights are burning the weight being floated, lifts the valve "19" high enough from its seat to supply the amount of air required. This also relieves the wearing parts of any weight that would wear them rapidly.

If all of the joints in the car are kept tight, it will require no attention after it is once set, and will be found to be very sensitive in its regulation of air from the reservoir under the car where the pressure may vary to the reduced constant pressure supplied to the Carburetters.

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FROST DRY CARBURETTER SYSTEM.

CLOSET NEEDLE VALVE.

PLATE L.

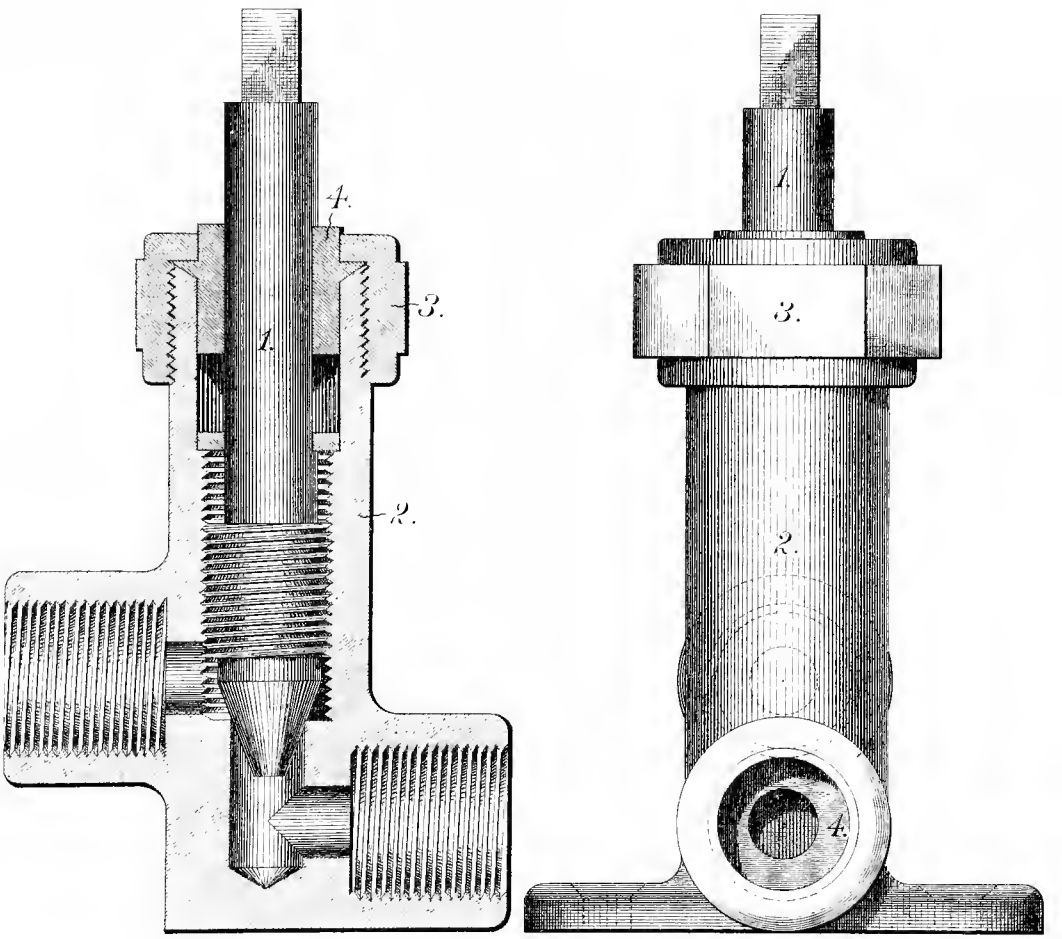
Needle,	1
Body of Valve,	2
Packing Nut,	3
Packing Follower,	4
Valve Wrench,	5

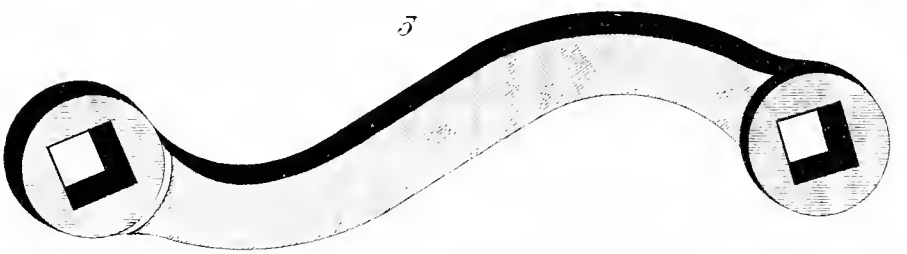
NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

CLOSET NEEDLE VALVE AND VALVE WRENCH.

PLATE L.





PATENTED.

FROST DRY CARBURETTER SYSTEM.

TANK NEEDLE VALVE.

PLATE M.

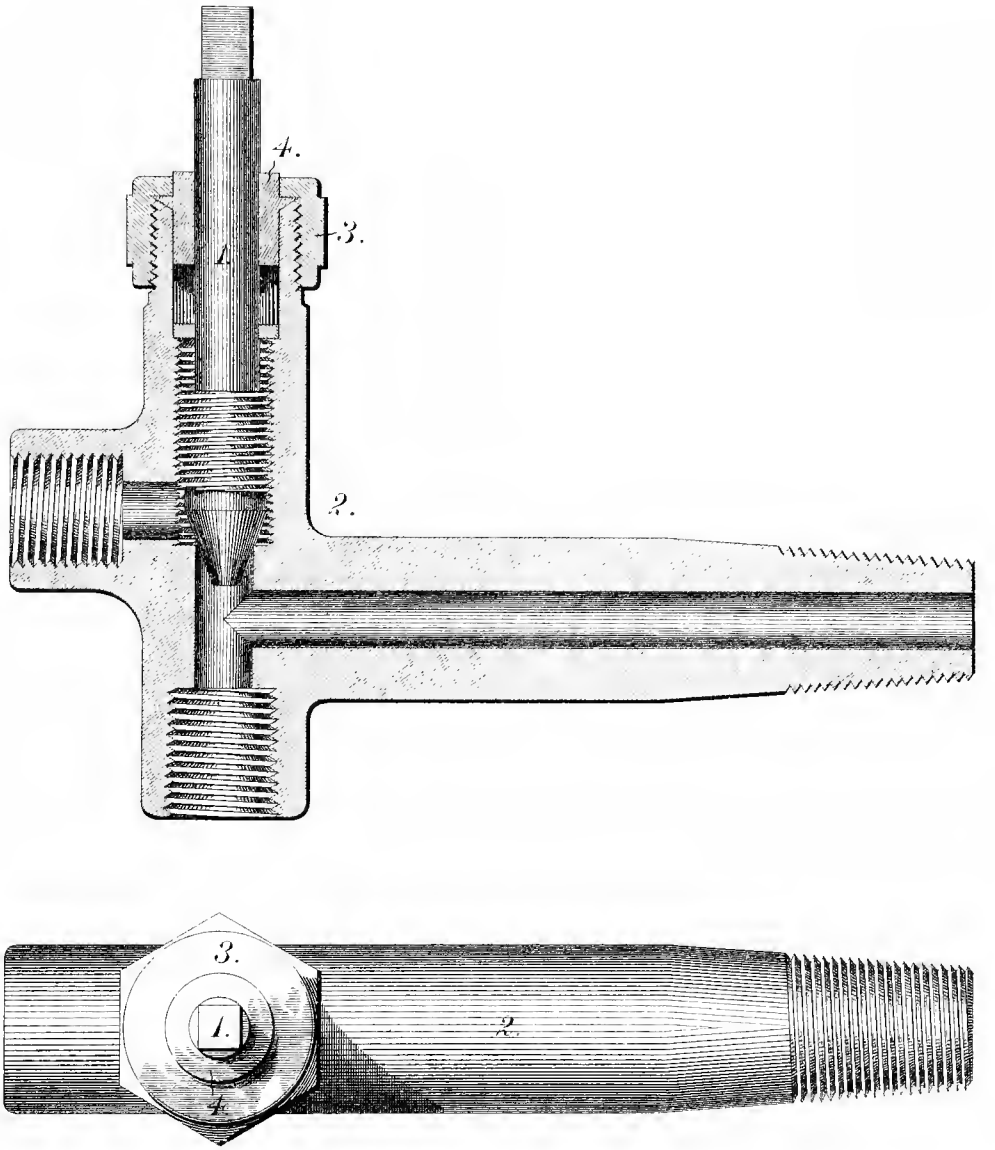
Needle,	1
Body of Valve,	2
Packing Nut,	3
Packing Follower,	4

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

TANK NEEDLE VALVE.

PLATE M.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

COMBINED DUST SCREEN AND CHECK VALVE.

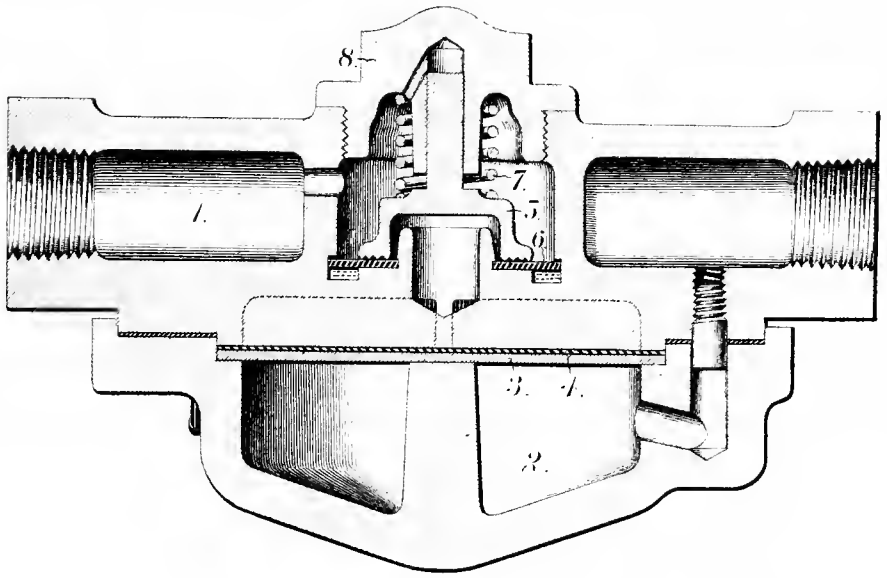
PLATE N.

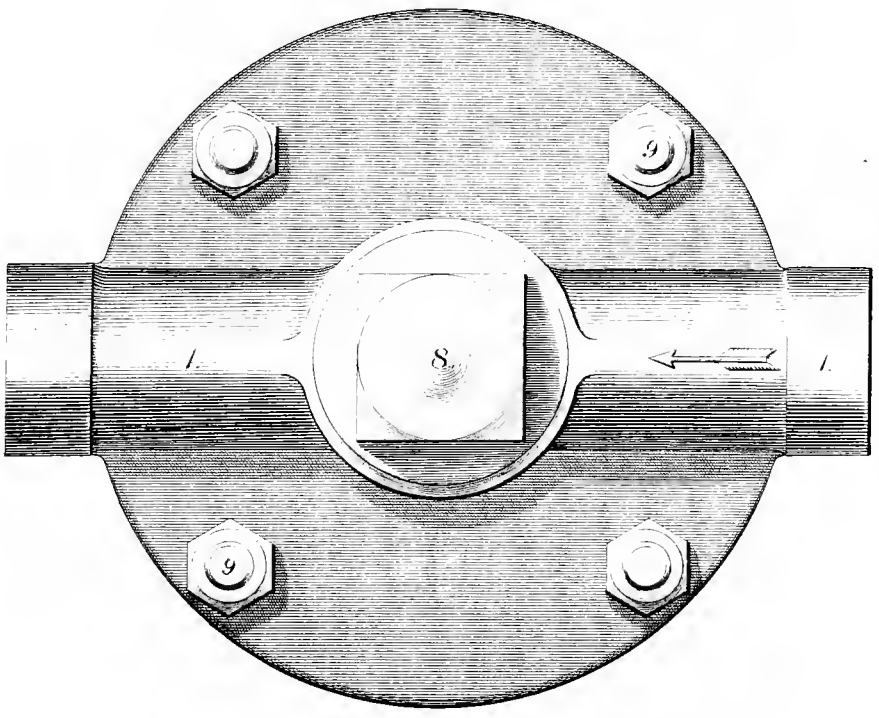
NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

COMBINED DUST SCREEN AND CHECK VALVE.

PLATE N.





PATENTED.

FROST DRY CARBURETTER SYSTEM.

CHARGING CAN.

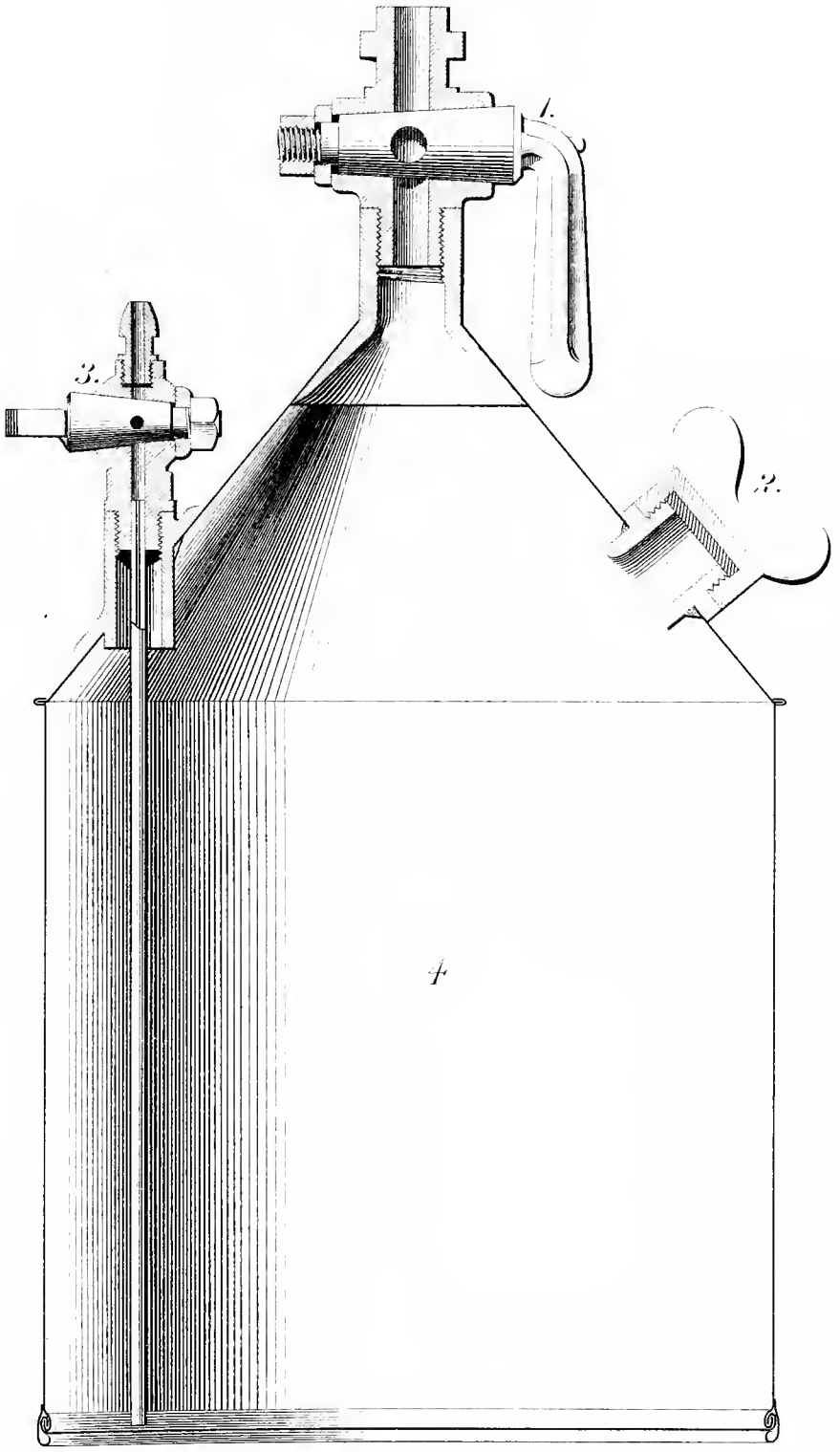
PLATE O.

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

CHARGING CAN.

PLATE O.



PATENTED.

FROST DRY CARBURETTER SYSTEM.

CHARGING CAN, EXTERIOR VIEW.

PLATE P.

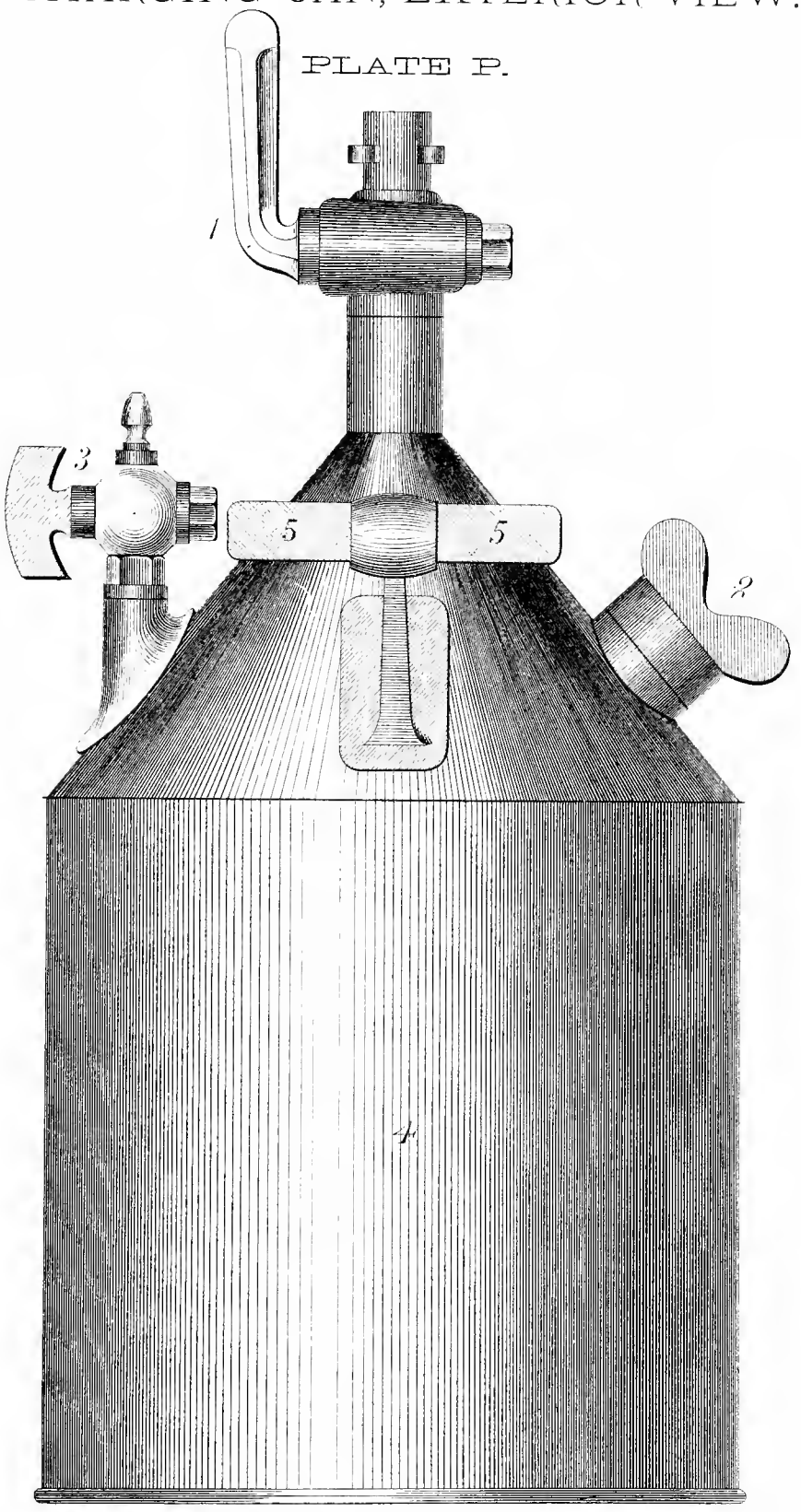
Main Cock,	1
Filling Hole Cap,	2
Discharge Cock,	3
Body of Can,	4
Handle,	5

NOTE.—In ordering, give letter of plate, page number and name and number of part from schedule.

FROST DRY CARBURETTER SYSTEM.

CHARGING CAN, EXTERIOR VIEW.

PLATE P.



THIS IS OUR ENTIRE PLANT OFF THE CAR.

PATENTED.

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